by the hydro-pneumatic gun-carriage has been sketched, it is evident that all the applications of the principle of utilising the recoil as embodied in this engine have not been exhausted. The force of the recoil which must be exhausted in bringing the gun down to the loading position is very much greater than the force that would be required simply to raise the gun again to the firing position. The recoil takes place very rapidly, much more rapidly than it is desirable that the gun should rise again. If in the Protected Barbette Carriage it was allowed to return freely to its firing position, it would come up with an inconvenient or even a dangerous violence. The superfluous energy of the recoil stored up in the counter-weight must, therefore, be controlled and exhausted by friction bands. In the hydro-pneumatic carriage the return of the gun can be completely controlled by the valve or stopcock G, so as to bring it to the loading position as gently as desired, and the superfluous energy of the recoil will take the form of heat developed in the compressed air of the reservoir. But this superfluous energy may be seized and utilised. If a second and smaller plunger is attached to the cross head of the main plunger, which supports the gun and its carriage, with a cylinder and reservoir of its own, the power there accumulated may be used for any other purpose, as training the gun and carriage. In this case also, though the pressure produced and the heat generated in the main reservoir will not be so great as if there was no second plunger, still it alone will contain an ample store of force to bring the gun again into its firing position.

To discuss the military advantage of this invention, as a substitute on board ships of war for a turret weighing 300 tons of wrought iron, affording more complete protection to gun and gunners, and not weighing for a twenty-five ton gun more than sixteen tons altogether, would be travelling out of the realm of Nature.

We have only endeavoured to show in this example with how great efficiency and docility Nature obeys those who understand how to direct her forces, and that all her work is not only efficient but instructive. If we can persuade her to undertake a new task she will teach us a new lesson. In the hydro-pneumatic gun-carriage a means supplies itself for measuring the exact amount of work done by the recoil. The compression of the air in the reservoir, and the heat generated in the process, will give accurate data for measuring the force exerted, and by this a step will be made towards measurements of the power of explosives with a precision hitherto unattainable.

Nature, like the great ancient fabulist, if she is compelled to be our slave, is resolved also to be our teacher.

NOTES

There is one part which neutrals may take in the Continental war. With no sympathy for those who have caused the war on either side, our sympathy is all the more due to those who innocently suffer from it on both sides. The following appeal, posted on the walls of every *mairie* in France, will touch other hearts than those of Frenchmen :—"*Appel à la France.*—Au nom de Dieu, au nom de la patrie, au nom de nos fils, de nos frères, de nos braves soldats tombés avec honneur sur le champ de bataille, et toujours héroïques quoique vaincus aujourd'hui, nous faisons un appel à tous les cœurs français. De grâce, donnez-nous de l'argent, du linge, des chemises, des couvertures, des vêtements, de flanelle, etc. Là-bas, sur nos frontières, l'élan des villes, les offrandes touchantes des villages ne suffisent déjà plus à nos chers blessés.—Les besoins sont immenses.—Le temps presse.—Donnez, oh! donnez vite! Envoyez les dons en nature et en argent au siége de la société à Paris, Palais de l'Industrie, porte No. IV." Here is a work in which all may unite—French, Germans, and neutrals, men of science, men of literature, men of business; and above all, our women. Nobly already have English, Irish, and Americans, surgeons, nurses, sisters of charity, come forward in the good work, but still it can only be as a drop in the ocean. To offer succour to the wounded and sufferers on both sides, to assuage as far as we can, the horrors of war, never exhibited on a more fearful scale than within the last few weeks, is now the duty of our more fortunate countrymen and countrywomen.

Another sacrifice of science to the war! The Congress of Alpine Geologists, the meeting of which we announced to take place on the 31st of this month, is adjourned to a more favourable time. It is probable also that the Congress of Anthropology and Pre-historic Archæology which it was proposed to hold at Bologna, and that of German naturalists to take place at Rostock, will not be held.

The following sectional arrangements of the British Association are now announced :—A—Mathematical and Physical Science (in the Crown Court, St. George's Hall) : President—J. Clerk Maxwell, F.R.S. L. and E. ; Secretaries—Prof. W. G. Adams ; W. K. Clifford ; Prof. G. C. Foster, F.R.S. ; Rev. W. Allen Whitworth. B—Chemical Science (in the Royal Institution, Moore Street) : President—Prof. Henry E. Roscoe, PhD., F.R.S., F.C.S. ; Secretaries—Prof. A. Crum Brown, F.R.S.E., F.C.S. ; A. E. Fletcher, F.C.S. ; Dr. W. J. Russell, F.C.S. C—Geology (in the Concert Hall, Lord Nelson Street) : President—Sir Philip de Malpas Grey Egerton, Bart., M.P., F.R.S., F.G.S. ; Secretaries—W. Pengelly, F.R.S., F.G.S. ; Rev. H. H. Winwood, F.G.S. ; W. Boyd Dawkins, F.R.S., F.G.S. ; G. H. Morton, F.G.S. D—Biology (in the Reading Room and Lecture Room of the Free Public Library) : President—Prof. G. Rolleston, M.D., F.R.S., F.L.S. ; Vice-Presidents—John Evans, F.R.S., F.G.S., F.S.A. ; Prof. Michael Foster, M.D., F.L.S. ; Secretaries—Dr. T. S. Cobbold, F.R.S., F.L.S. ; Thos. J. Moore ; H.T. Stainton, F.R.S., F.L.S., F.G.S. ; Rev. H. B. Tristram, LL.D., F.R.S. E—Geography (in the Small Concert Room, St. George's Hall) : President—Sir Roderick I. Murchison, Bart., K.C.B., D.C.L., LL.D., F.R.S., F.G.S. ; Secretaries—H. W. Bates, Assist. Sec. R.G.S. ; Clements R. Markham, F.R.G.S. ; Albert J. Mott ; J. H. Thomas, F.R.G.S. F—Economic Science and Statistics (in the Council Chamber, Town Hall) : President—Prof. Jevons ; Secretaries—E. Macrory ; J. Miles Moss. G—Mechanical Science (in the Civil Court, St. George's Hall) : President—Charles Vignoles, C.E., F.R.S., M.R.I.A., F.R.A.S. ; Secretaries—P. Le Neve Foster ; J. T. King.

The Dutch Society of Sciences, of Haarlem, instituted last year, in addition to its ordinary prizes, two large gold medals, each of the value of 500 florins, one of which bears the name and effigy of Huyghens, the other of Boerhaave. These medals are to be awarded alternately, once in two years, to the *savant*, Dutch or foreigner, who shall have contributed the most, during the previous twenty years, to the progress of one particular branch of mathematical physics or of natural science. The Huyghens medal is to be devoted in 1874 to chemistry, in 1878 to astronomy, in 1882 to meteorology, in 1886 to mathematics, pure and applied. The Boerhaave medal is to be granted in 1872 to mineralogy and geology, in 1876 to botany, in 1882 to zoology, in 1884 to physiology, in 1888 to anthropology. The series will then recur. At their recent annual meeting the society made the first award of the Huyghens medal to M. Clausius for his discoveries in thermo-dynamics.

Sir Frederick Pollock, late Chief Baron, whose death is announced as having taken place on Tuesday last, in the 87th year of his age, was an amateur photographer of no mean ability, and had been President of the London Photographic Society ; he was an occasional contributor of articles on photography to the Philosophical Proceedings of the Royal Society.

He received his education at St. Paul's School and Trinity College, Cambridge, and was Senior Wrangler and First Smith's Prizeman in 1806.

THE Duke of Argyll writes to the *Times* to say that a remarkable meteor which was visible in the north of England on the 15th inst., was also seen at Inveraray. "It burst," the Duke says, "about 50 degrees above the horizon in the N.N.W., and its great peculiarity was in the appearance presented by the luminous vapour which was the product of its explosion. This vapour was brighter than the tail of any comet—at first linear in shape—with sharp irregular projections. It was soon, however, curled up, as if by an atmospheric current, into the form of a horse-shoe, and in this form seemed to drift very slowly before the north-east wind in a south-west direction. It gradually, but very slowly, lost its brilliancy, remaining visible for more han a quarter of an hour." Two other correspondents of the *Times* describe a very brilliant meteor which was seen in Cambridgeshire on Saturday night.

A WATERSPOUT was observed off Calais on Saturday evening. From the edge of a thick black thunder-cloud two funnel-shaped projections were seen to depend, until they gradually reached the surface of the sea, on which they created a great disturbance, masses of foam rising up to a considerable height around the foot of each waterspout. It was calculated that the long streamers hanging down from the cloud to the sea were nearly a mile in length. The wind caused them to wave about gently and alter their form slightly from time to time. One of the waterspouts lasted about ten minutes, and the other about a quarter of an hour. During this time they moved rapidly along the sea.

ON Saturday evening, August 20, between 11 P.M. and midnight, a very beautiful aurora borealis was seen near Weobley, in Herefordshire, stretching from N.N.E. to N.W., and visible, with more or less distinctness, for about three hours.

THE *Engineer* states that an exhibition is about to be opened in Tromso, the capital of Finmark. The exhibition will contain the products and appliances used in the several fisheries, those of agriculture, and of mechanical and domestic industry, together with objects and products illustrative of the mode of life and state of civilisation of the inhabitants of those regions.

WE recorded recently the purchase by the Belgian Government of the Martius herbarium as the nucleus of a national collection. The same Government has now also purchased the Brussels Botanic Gardens from the Belgian Horticultural Society. The capital of Belgium has thus laid the foundation of a national establishment comparable to those of Paris and London.

THE Treasurer's report of the British Medical Congress, which has just been sitting for four days at Newcastle-on-Tyne, shows that out of an income of 5,000*l.* per annum it spends just 15*l.* on scientific research. It is stated that the greater part of the funds are required to keep afloat its own journal, and that a proposition from some of the members to publish an annual volume of Transactions found but little favour.

TWO instances are recorded in *Les Mondes* of somnambulism being perfectly cured by the administration of bromide of potassium. In one case, a woman of the age of twenty-four who had been subject to attacks two or three times a week for ten years, was operated upon; the dose given was two grammes of the bromide in seventy-five of water per diem, gradually increased to six grammes; the attacks became at once less and less frequent, and entirely ceased at the end of two months. In the other case, a girl of eight was the subject; one gramme was given morning and evening, and the cure was complete and immediate.

WE have received a specimen of paper manufactured entirely from wood, which is at least equal in colour and texture to the cheaper kinds of ordinary printing paper. There is no doubt that the pulp from the fibre of the fir and some other kinds of wood makes excellent material for paper, which can be prepared at a low price, the only practical difficulty being the high temperature and consequently the high pressure required to decompose the non-fibrous matter. Another material now actually employed for the manufacture of paper, is the husk and seeds of the cotton-pod from which the oil has been expressed, the fibrous pulp resulting from this operation is said to be an excellent paper-making material. The larger portion of the cheaper printing-papers used for newspapers, magazines, &c., is now made entirely from the Spanish Esparto grass, a name given to two distinct species, *Macrochloa tenacissima*, and *Lygeum spartum*, both growing abundantly on the shores of the Mediterranean; but the comparatively high price of this material, more than double what it was a few years since, affords a favourable opening for the introduction of other paper-making fibres.

PROFESSOR ORTON does not give a very encouraging account of the intellectual condition of Ecuador. He says:—"Ecuador boasts one university and eleven colleges, yet the people are not educated. Literature, science, philosophy, law, and medicine, are only names: there is not a single book-store in the city of Quito, and there are only four newspapers published in the whole of the Republic. In the schools the pupils study in concert aloud, Arab fashion." Yet Professor Orton adds that Chile has thought it worth her while lately to sign a convention with Ecuador "for an exchange of literary productions!"

THE Government of Nicaragua has sent an expedition under Mr. Sonnenstern, a civil engineer, to examine whether the River Coco can be made navigable. The report of Mr. Sonnenstern, which is favourable, has been published in the *Gazette* of Nicaragua. The river has hitherto been little known. The Indians are stated to be indolent and docile, and might, by contact with settlers, be civilised.

THERE is a rumour in California that a large quicksilver deposit has been discovered in the coast mountains eastward of San José.

THE Ecuador Government has decreed that in the capital and suburbs no house constructed of cane and straw shall be permitted, and that three months after the date of the decree all those existing shall be demolished. There was a former decree to this effect, which is thus fully enforced.

THE old Palace of Government at Lima, in Peru, is condemned, and a new one, which is to be a stone palace from the designs of M. Zoiles, architect and engineer, is to be built. In preparation, the ministerial departments have been removed from the old building.

THE Federal Government of the United States of Columbia has paid a debt to the state of Panama by the transfer of house property in Panama, which is to be converted into a college for that city.

THE Rev. W. A. Leighton, of Shrewsbury, author of the "Flora of Shropshire," is preparing for publication "A Lichen Flora of Great Britain, Ireland, and the Channel Islands."

WE have to acknowledge the receipt of "Hogg's Secret Code for Letters or Telegrams," with instructions for converting a message into ciphers, and for converting ciphers into a message.

THE Rev. Prof. Haughton reprints from the *Dublin Quarterly Journal of Medical Science* his paper "On the Muscular Forces employed in Parturition, their amount and mode of application."

KARL FRITSCH'S "Phänologische Beobachtungen aus dem Pflanzen und Theirreiche" contains an immense mass of observations taken in the neighbourhood of Vienna and other districts of Austria, in the year 1857 (but now for the first time published), on what may be termed periodical natural history, that is, the period of the first flowering of plants, and the first appearance of migratory birds, insects, and other animals of the summer season.

THE last volume (XIX.) of the Transactions of the Imperial Zoological-Botanical Society of Vienna contains, among its more important articles, contributions to the flora of Greece and Crete, by Dr. E. Weiss; a monograph of the genus *Botrychium*, by Dr. J. Milde (reducing the thirteen species in Moore's Index Filicum to ten); anatomical investigation of *Pleurophyllidia formosa*, by R. Bergh; a second contribution to the flora of Lower Austria, by Dr. A. Neilreich: observations on the metamorphosis of insects in the light of the theory of descent, by F. Brauer (a thoroughly Darwinian article); contributions to Hymenopterology, by Dr. J. Kriechbaumer; descriptions of several Myriapods in the Museum of Vienna, by MM. A. Humbert and H. de Saussure; the Lichens of the Tyrol, by F. Arnold; zoological notes, by G. Ritter von Frauenfeld; contributions to the Fish-fauna of Trans-baikal, by B. N. Dybowski.

IN the "Arbeiten aus der Kiel Institut" we observe that Klünder has been making further investigations into the time occupied in muscular contraction. His experiments have been conducted with a pendulum chronoscope constructed by Hensen. The contraction is traced on a reddened glass plate attached to the arm of a tuning fork, with which it therefore vibrates when this is sounded. The curve described is consequently a sinuous line, its ascending and descending portion decussating. If a vertical median line be drawn on the plate when at rest, the measurements can be examined and compared. These give for the stage of latent excitation a value of $\frac{3}{400}$ths of a second, which, when the muscle is weighted or exhausted, may rise to more than 0·01 sec. Antecedent extension diminishes the duration of this period, as Helmholtz had already remarked. The proper curve of contraction exhibits itself in its middle part as a curved line modified by the elasticity of the muscle. The muscle is quite inactive towards the end of contraction, as shown by the form of the extremities of the curve. The greatest increase in rapidity occurs in the ascending portion of the curve, which corresponds to the greatest development of force in the muscle which is between the 3rd and 4th 1-400 of a sec., the absolute greatest rapidity of the ascent is in the 8th 1-400 sec. The form of the curve is, considerably changed if a heavy weight is appended to the muscle, the period of elevation as well as the fall being both longer. The retardation occurs principally at the commencement of the elevation, at which period the rapidity only slowly increases, as compared with its usual rate.

THE COMING TRANSITS OF VENUS*

TRANSITS of Venus over the disc of the sun have more than any other celestial phenomena occupied the attention and called forth the energies of the astronomical world. In the last century they furnished the only means known of learning the distance of the sun with an approach to accuracy, and were therefore looked for with an interest corresponding to the importance of this element. Although other methods of arriving at this knowledge with equal accuracy are now known, the rarity of the phenomenon in question insures for it an amount of attention which no other system of observation can command. As the rival method, that of observations of Mars at favourable times, requires, equally with this, the general co-operation of astronomers, the power of securing this co-operation does in itself give the Transits of Venus an advantage they would not otherwise possess.

Although the next transit does not occur for four years, the preliminary arrangements for its observation are already being made by the governmental and scientific organisations of Europe. It is not likely that our Government will be backward in furnishing the means to enable its astronomers to take part in this work. The principal dangers are, I apprehend, those of setting out with insufficient preparation, with unmatured plans of observation, and without a good system of co-operation among the several parties. For this reason I beg leave to call the attention of the Academy to a discussion of the measures by which we may hope for an accurate result.

In planning determinations of the solar parallax from the Transits of Venus, it has hitherto been the custom to depend entirely upon the observations of the internal contact of the limbs of the sun and planet proposed by Halley. It is a little remarkable, that while astronomical observations in general have attained a degree of accuracy wholly unthought of in the time of Halley, this particular observation has never been made with a precision at all approaching that which Halley believed that he himself had actually attained. In his paper he states that he was sure of the time of the internal contact of Mercury and the sun within a second. The latest observations of a transit of Mercury, made in November 1868, are, as we shall presently see, uncertain by several seconds. It is also well known that the observations of the last transit of Venus, that of June 1769, failed to fix the solar parallax with the certainty which was looked for, the result of the standard discussion being now known to be erroneous by one-thirtieth of its entire amount. One of the first steps to carry out the object of the present paper will be an inquiry into the causes of this failure, and into the different views which have been held respecting it.

The discrepancies which have always been found in the class of observations referred to, when the results of different observers have been compared, has been generally attributed to the effect of irradiation. The phenomenon of irradiation presents itself in this form: When we view a bright body, projected upon a dark ground, the apparent contour of the bright body projects beyond its actual contour. The highest phenomenal generalisation of irradiation which I am aware of having been reached is this: A lucid point, however viewed, presents itself to the sense, not as a mathematical point, but as a surface of appreciable extent. A bright body being composed of an infinity of lucid points, its apparent enlargement is an evident result of the law just cited.

[The speaker here drew a number of diagrams for the purpose of illustrating his theory.]

The following diagrams show the effect of this law upon the time of interval contact of a planet with the disc of the sun. The planet being supposed to approach the solar disc, Fig. 1 shows the geometrical form of a portion of the apparent surface of the sun, or the phenomenon as it would be if there were no irradiation immediately before the moment of internal contact. Fig. 2 shows the corresponding appearance immediately after the contact. To indicate the effect of irradiation, or to show the phenomenon as it will actually appear on the theory of irradiation, we have only to draw an infinity of minute circles for each point of the sun's disc visible around the planet to indicate the apparent phenomenon. The effect of this is shown in Figs. 1*a* and 2*a*. The exceedingly thin thread shown in Fig. 1 is thus thickened as in 1*a*, and the sharp cusps of Fig. 2 are rounded off as shown in Fig. 2*a*. The apparent radius of the planet is diminished by an amount equal to the radius of the circle of irradiation, and the radius of the sun is increased by the same amount. Comparing Figs. 1*a* and 2*a*, it will be seen that the moment of internal contact is marked by the formation of a ligament, or "black drop," between the limbs of the sun and the planet. This formation is of so marked a character that it has been generally supposed there could be little doubt of the moment of its occurrence. The remarks of the observers have given colour to this supposition, the black drop being generally described as appearing suddenly at a definite moment.

Examining Fig. 2*a*, it will be seen that the planet still appears entirely within the disc of the sun. The geometrical circle which bounds the latter, and that which bounds the planet, instead of touching, are separated by an amount equal to double the irradiation. And, when they finally do touch, neither of them will be visible at the point of contact. The estimate of the moment of contact must therefore be very rough, the means of estimating being far less accurate than those afforded by a common filar micrometer. In the actual case the eye has to continue the two circles to the point of contact by estimation, through a distance depending on the amount of irradiation, while measures with a micrometer are made by actual contact of a wire with a disc. Such estimates have, therefore, been

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* Substance of a paper read before the Thirteenth Annual Session of the American Academy of Sciences, held at Washington, by Prof. Simon Newcomb. (The original paper was illustrated by diagrams.)